(No Model.) 4 Sheets—Sheet 1.

H. S. HOPPER.

AIR BRAKE MECHANISM.

No. 430,024. Patented June 10, 1890.

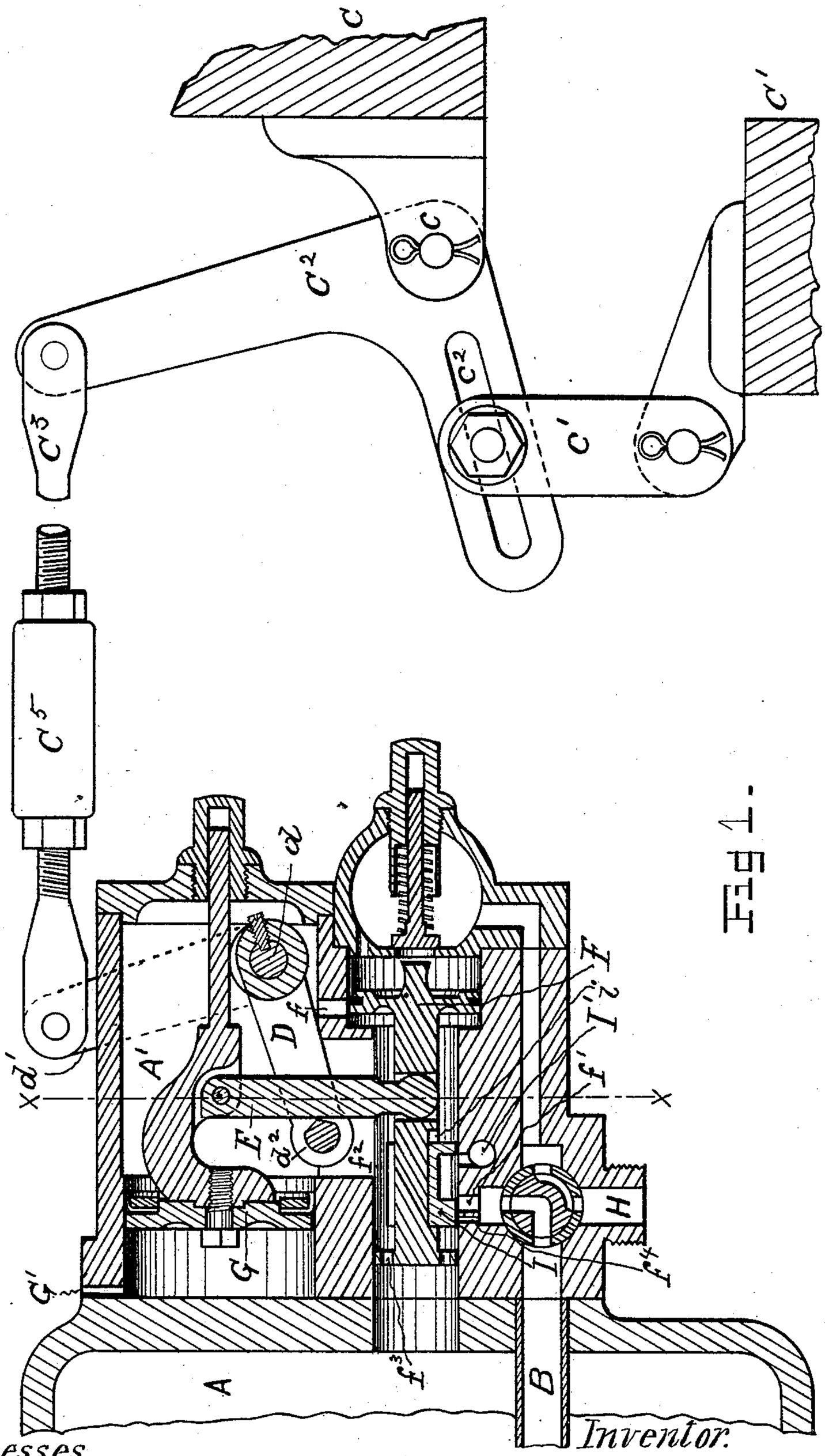

Fig 1.

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(No Model.)

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AIR BRAKE MECHANISM.

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Fig. 3.

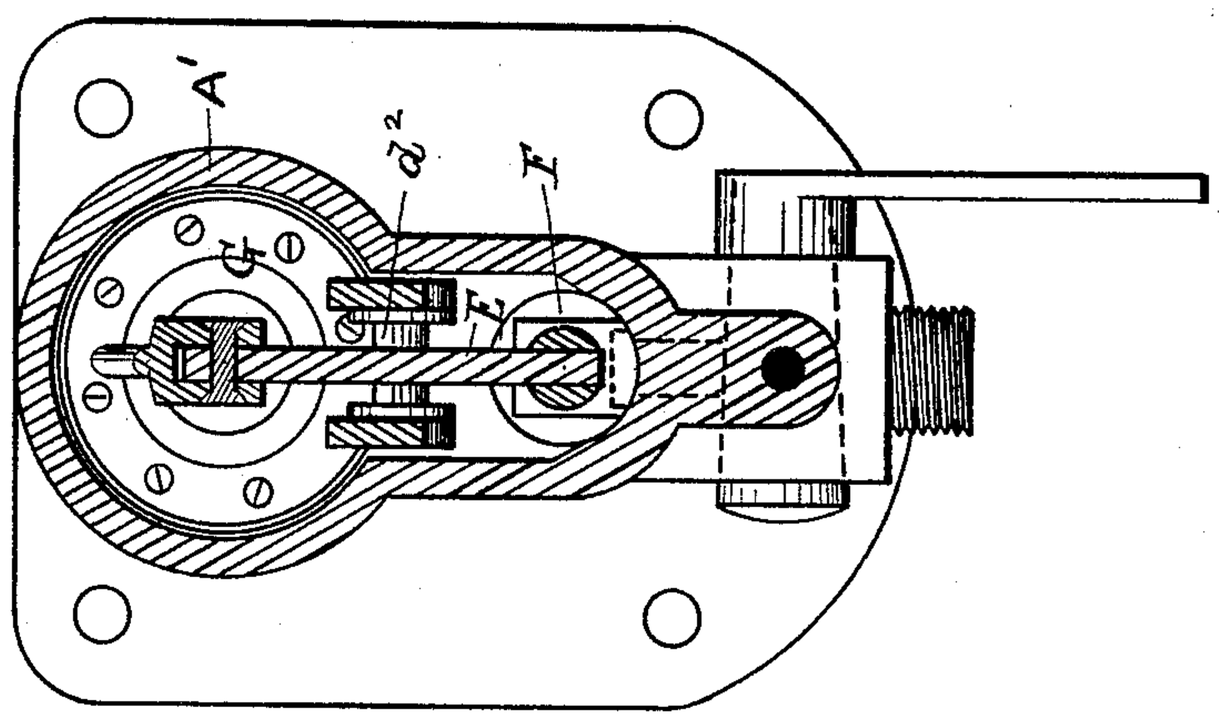
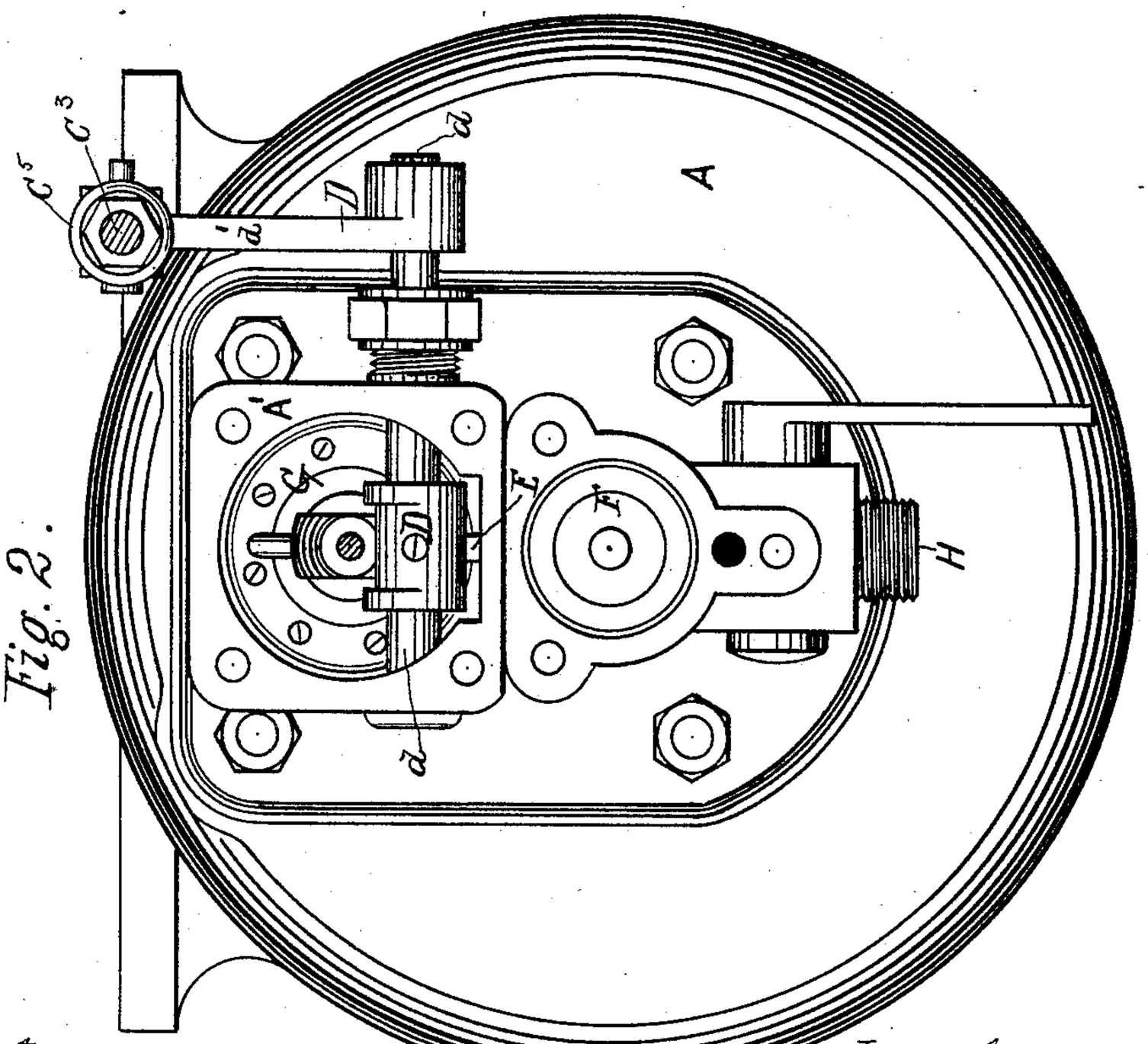


Fig. 2.



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AIR BRAKE MECHANISM.

No. 430,024. Patented June 10, 1890.

Fig. 4.

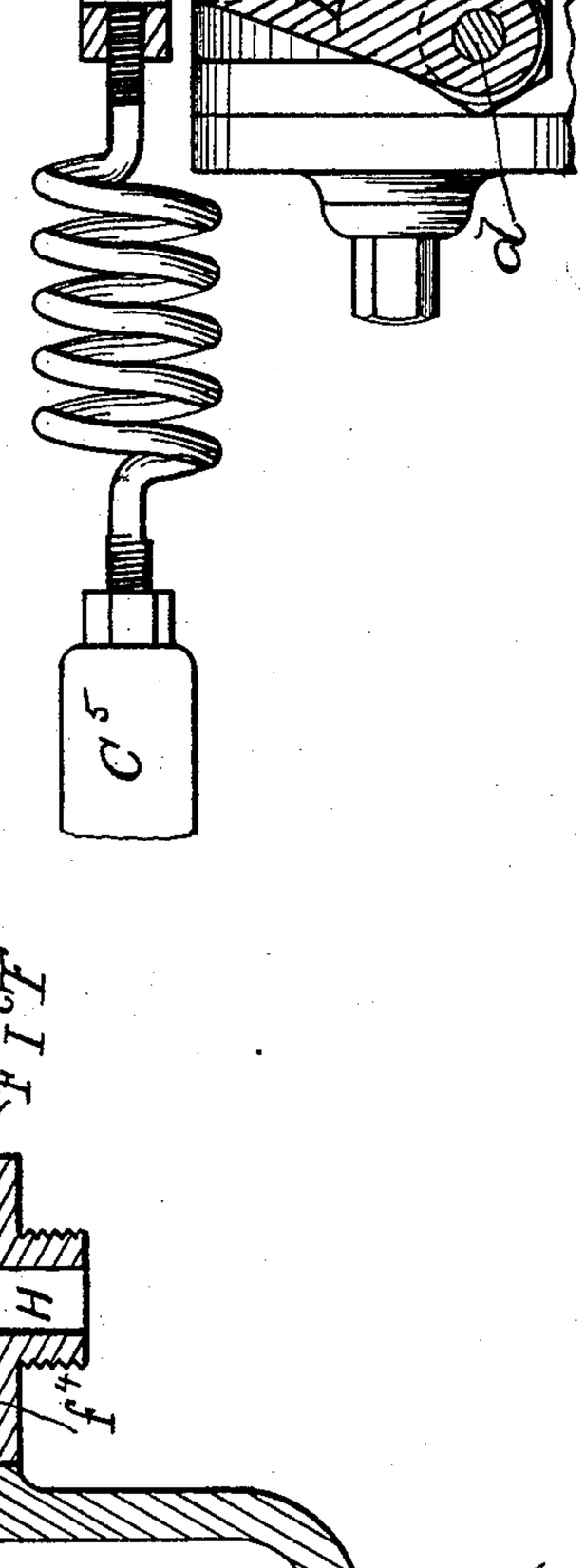

Fig. 5.

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AIR BRAKE MECHANISM.

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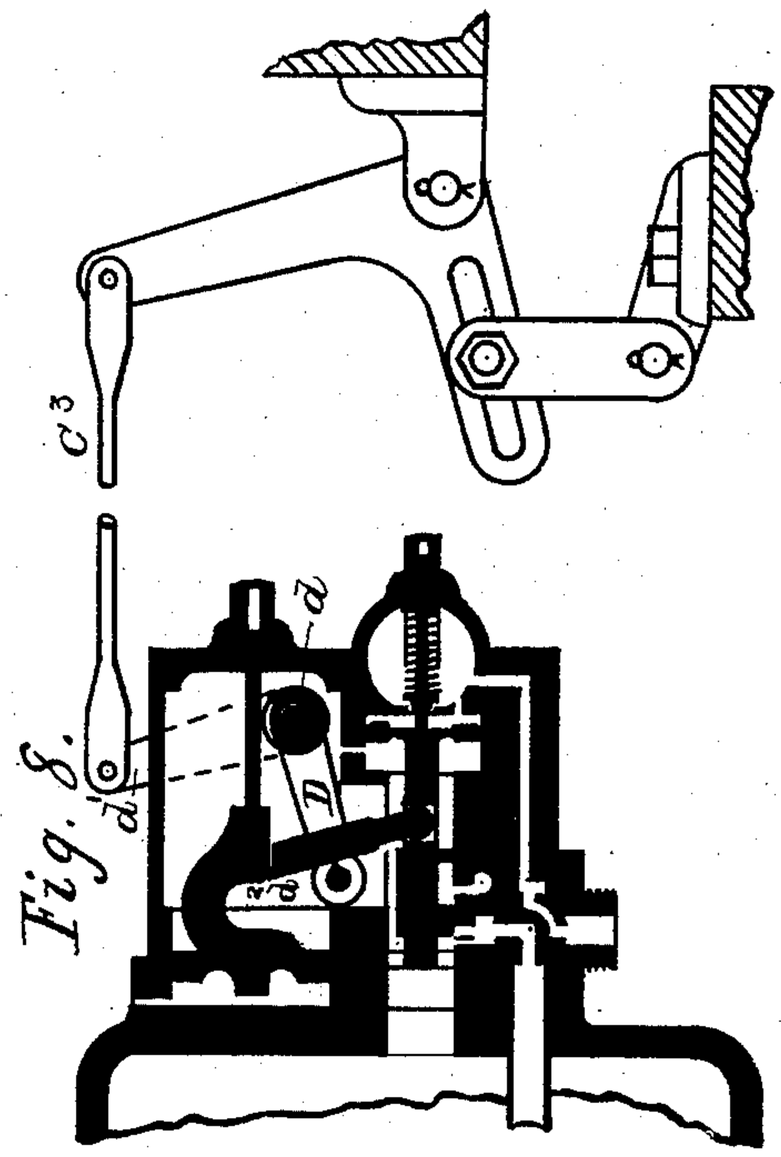


Fig. 8.

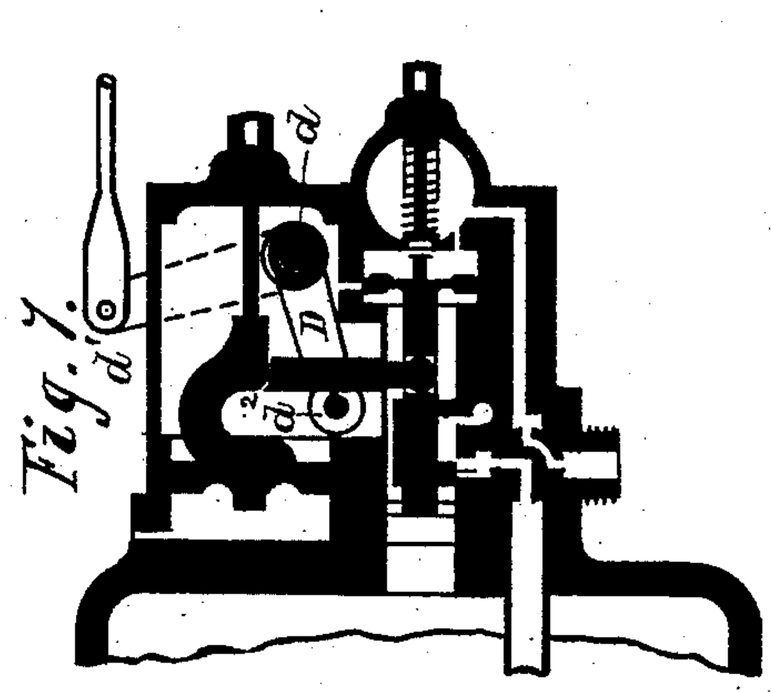


Fig. 7.

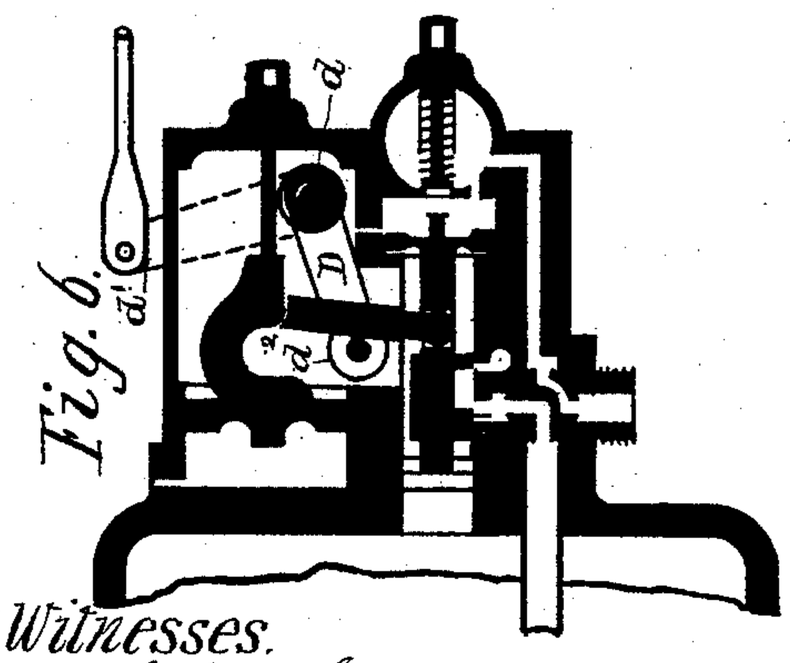


Fig. 6.

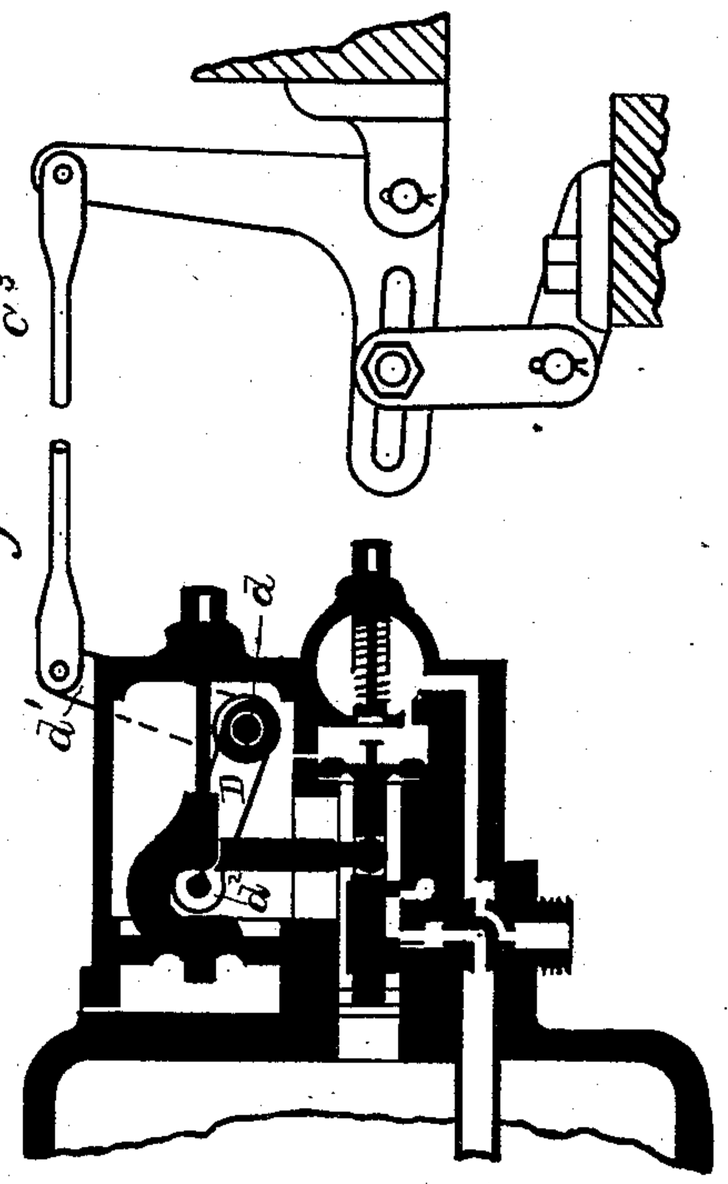


Fig. 10.

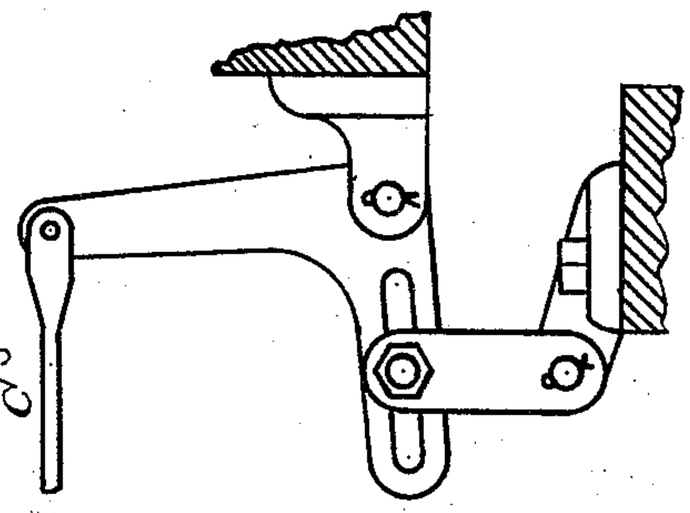
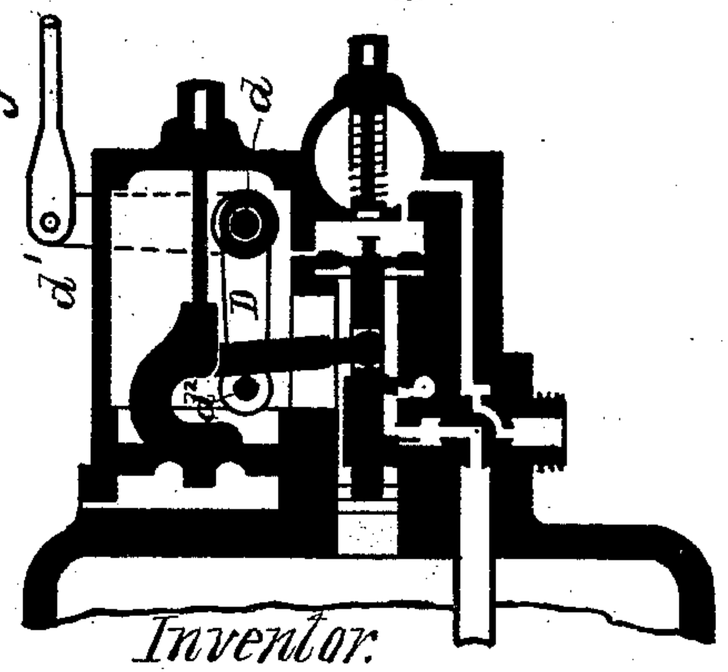


Fig. 9.



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UNITED STATES PATENT OFFICE.

HENRY S. HOPPER, OF DETROIT, MICHIGAN.

AIR-BRAKE MECHANISM.

SPECIFICATION forming part of Letters Patent No. 430,024, dated June 10, 1890.

Application filed November 8, 1889. Serial No. 329,608. (No model.)

To all whom it may concern:

Be it known that I, HENRY S. HOPPER, a citizen of the United States, residing at Detroit, county of Wayne, State of Michigan, have invented a certain new and useful Improvement in Air-Brake Mechanism; and I declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

In the drawings, Figure 1 is a sectional view illustrating my invention. Fig. 2 is an end elevation with parts removed, looking against the end of the auxiliary air-reservoir. Fig. 3 is a sectional view on the line *x x* of Fig. 1. Fig. 4 is a view similar to Fig. 1, but illustrating mechanism for neutralizing the effects of jogs and jars upon the car-springs incident to their ordinary use and means for recharging the auxiliary reservoir while the brakes are set or partially set. Fig. 5 is a view of the dash-pot mechanism hidden from view in Fig. 4. Figs. 6, 7, 8, 9, and 10 are diagrammatic views showing the operation of the mechanism under varying conditions. Fig. 6 shows the position of the parts when starting to charge the auxiliary air-reservoir and train-pipe. Fig. 7 shows their position when the pressure in the train-pipe has reached its maximum, that in the auxiliary air-reservoir having reached the lower pressure adequate for its car when empty and having cut off further pressure. Fig. 8 shows the same when pressure in the train-pipe has been relieved to set the brakes for a service stop. Fig. 9 shows the position of the parts corresponding to Fig. 6, except that the car having been partially loaded the fulcrum of the governing-lever has been shifted to correspond with this change of load. Fig. 10 shows the same with the fulcrum automatically shifted to correspond with a maximum load on the car.

My invention has for its object to produce an air-brake for any cars, and more particularly one adapted specially for freight-cars, wherein the load varies widely from that of an empty car to the same with its maximum load; also, to produce means whereby the auxiliary air-reservoir may be recharged while the brakes are set; also, to provide means whereby the usual flexing of the car-springs, due to the roughness of the road in ordinary transit, may be neutralized, so as not to affect the air-brake mechanism nor change the adjustment it has automatically taken corresponding with the load the car is carrying; also, in the provision of means whereby the apparatus may be adjusted at will on any car to conform to the particular range of motion to which its springs are subjected from its empty to its loaded condition, and that the mechanism governing the admission of air to the auxiliary air-reservoir shall be at its proper adjustment, conforming to an unloaded car even though the springs of different cars may, when empty, stand at different degrees of compression, and other features of construction.

In carrying out my invention, A represents the auxiliary air-reservoir; B, the pipe or conduit leading to the brake-cylinder. (Not shown.)

C is the body of the car on which the apparatus is applied.

C′ is the transom or other stationary part of the truck-frame. To one of these parts—*i. e.*, the truck or body bolster, but preferably the body-bolster—is supported at its fulcrum *c* a lever C^2. One of its arms is engaged with the other part through the medium of a link at *c′*. The other end of this lever is engaged with the connecting rod or bar C^3, which unites it with the arm *d′* of the lever D. There is a helical or other spring C^4 on the line of the rod C^3 and a turn-buckle C^5, and one of the arms of the lever C^2 is slotted at c^2. The lever D is fulcrumed at *d*, and its free end d^2 constitutes the movable fulcrum of another lever E. This lever E is at one end engaged with the small piston F and at its other end with the large piston G.

H is the conduit connecting with the train-pipe.

I will now describe the operation of the primary parts of the apparatus.

We will suppose, for instance, that the area of the large piston G is just twice that of the small piston F, and there is no pressure at all in the train-pipe. The moment

pressure begins it acts upon the small piston F to bring all the parts to the position shown in Fig. 6, *f* being open, the passages from the auxiliary reservoir to the brake-cylinder closed, and the brake-cylinder open through *f'* and the valve I, with the exhaust-port I'. Now the engineer proceeds to establish a normal pressure in the train-pipe of, say, sixty pounds. As the pressure accumulates, the air passes through *f*, thence through f^2 and f^3, and into the auxiliary reservoir A. It is manifest that the pressure in the ante-chamber A' is always the same as in the auxiliary reservoir. It accumulates more rapidly outside the small piston F, because it has to pass hence through the restricted orifice *f*. Soon, however, a pressure of, say, sixty pounds has accumulated in front of F, while in the auxiliary reservoir A and ante-chamber A' it has reached, say, twenty pounds. We then have a direct pressure in front of the piston F of sixty pounds and twenty pounds backward from within, or a preponderance of but forty pounds from in front. It will be observed, however, that the twenty pounds of pressure in the ante-chamber is pressing the piston G with twice the force that it is acting on the back side of the piston F, or with forty pounds of energy, and this by the lever D is transmitted also to the back of F, and added to the twenty pounds of air-pressure just neutralizes or comes to an equilibrium with the pressure from the train-pipe. The further admission of air through the port *f* causes the piston G to move forward and so presses out the piston F and closes the port *f*. We therefore now have the parts again at rest, as shown in Fig. 7, and with sixty pounds in the train-pipe and only twenty in the auxiliary air-reservoir with which to operate the brakes. Now suppose we want to make a service stop or check slightly on a downgrade. Air is permitted to escape somewhat from the train-pipe. This causes the outward pressure on the back of F to preponderate. The piston is forced out, opening only the small orifice f^4 for air to pass from the auxiliary reservoir to the brake-cylinder. The relief thus afforded soon re-establishes an equilibrium back of and in front of F, and as soon as the pressure in front preponderates the piston recedes and opens the port *f*. The valve I, however, has a little play, as shown at *i*, and as the piston F recedes gradually it finally overtakes and moves the valve I just enough to close the passage f^1 without opening the brake-cylinder to the exhaust, and the pressure is permitted to again accumulate in the auxiliary reservoir while the brakes are yet set. As soon as an equilibrium is again established with the reduced pressure in the pipe the piston F is forced out and closes off the port *f* without moving the valve I. Now, to release the brakes, pressure in the train-pipe is brought up suddenly in the usual way, which operates to force the piston F quickly backward to its full stroke, and this carries the valve I to a point where it opens the brake-cylinder to the exhaust I' and brings all the parts to the position shown in Fig. 6.

D' is a dash-pot, within which plays the plunger D^2, which is connected with the lever D. Its purpose is to prevent any sudden motion or vibration of the lever D, due to the jolting of the car, and compelling the spring C^4 to yield to accommodate these vibrations, which is the function of the said spring.

G' is a vent-orifice, and *g* a valve adapted to open freely when the piston G is forced inwardly by pressure from the chamber A', and *g'* is a small orifice, through which air may enter slowly when the preponderance of pressure is in front of the piston F, and so permitting the piston G to return slowly to its initial position. Thus a dash-pot is formed, and the connection with the piston F causes the latter to retract with the same reduced speed as the piston G.

In line with the piston F is a spring J' beyond it. It is apparent that when this spring is compressed the valve is open, and air from the train-pipe may escape through ports *j* to the exterior. This valve is upon its exterior constructed to form a dash-pot, and on the dash-pot rod J^2 is a spring J^3, which operates in aid of the spring J' to hold the valve J closed against its seat. Now for a service stop the engineer relieves slightly the pressure in the train-pipe, which brings the projection from the piston F to or nearly to the dash-pot rod J^2; but when he wishes to make an emergency stop he wishes to stop as quickly as possible. He therefore relieves as much as he can his train-pipe. This causes the piston F to come back to the end of its stroke, and, added to whatever pressure may yet remain in the train-pipe, the valve J is forced from its seat, and the pressure in the train-pipe is still further relieved at this point without the air having to pass back through the train-pipe. As soon, however, as the pressure has been thus relieved by forcing in the dash-pot rod, the air in the dash-pot naturally escaping past the plunger under the influence of the spring J', the valve J is again closed on its seat and so stops further escape from the train-pipe and saves whatever degree of pressure may yet remain in the train-pipe. As soon as pressure is again accumulated in front of the piston F it is forced backward, the dash-pot rod resuming its initial position and its spring J^3 acts to assist the spring J' to hold the valve to its seat, the two being ample to hold it closed against the maximum pressure in the train-pipe. This mechanism also serves as a safety-valve to prevent any unduly great pressure in the train-pipe should its pressure-governor become disordered.

I will now describe how the apparatus is designed to change automatically to correspond with different loads on the car. It will be observed that by shifting the fulcrum d^2 on the lever E toward or from the piston G this piston will react with correspondingly

less or greater energy against the back of the piston F. So, also, it will be observed that weight or load added to the car will act to pull the rod C^3 and lever D, and so serve to shift the fulcrum d^2 toward the piston G, while removing the load will operate to shift it toward the piston F. Now, to effect the proper adjustment of the parts, we will suppose that in the instance illustrated it requires a working-pressure in the auxiliary reservoir of twenty pounds in order to set the brakes on the car when empty without causing its wheels to slide on the track. Under these conditions the rod C^3 is by the turn-buckle C^5, or otherwise, so adjusted that the fulcrum d^2 shall be at the middle of the lever E when the car is empty. Now when the car has been loaded to its maximum the engagement at the slot c^2 in the lever C^2 is so adjusted that the fulcrum d^2 shall then rest at a point on the lever E nearer to the piston G, which will just brake the wheels without permitting them to slide. It is now evident that with variations of the load between these limits the said fulcrum d^2 will be automatically shifted to correspond therewith; and, finally, it is obvious that the heavier the load the nearer is the fulcrum d^2 shifted toward the piston G, and the greater the amount of pressure required to accumulate in the ante-chamber A′ before it will operate to neutralize that on the piston F and cause the latter to move out and cut off the port *f*, and so automatically graduating the working-pressure in the auxiliary chamber to correspond with the load on the car at all times.

I do not wish to limit myself in every instance to constructions which shall possess each and every one of the features which I have described or illustrated. Thus, for instance, the spring in the rod C^3 might be dispensed with, although I prefer to employ it, or some other yielding element might be introduced at this or some other point in the connections for a like purpose. So, also, the turn-buckle may be dispensed with or another means of adjustment be provided. Again, the dash-pots, while they conduce to any easy and cushioned action, are not absolutely essential, though preferable, for other yielding resistances might be employed. Other minor details may also be varied without departing from the spirit of my invention, and I would have it understood that instead of the single brake-valve the common form of main and auxiliary valves at this point might be employed.

The pistons F and G may be of any desired relative sizes with respect to each other. In the foregoing description the piston G has been, for convenience of description only, presumed to be of twice the area of the piston F; but the relative sizes may be varied to any desired extent.

What I claim is—

1. In an air-brake mechanism, the combination, with the train-pipe, auxiliary reservoir, brake-cylinder, and triple-valve-operating piston, of valve mechanism connected with said piston, whereby the pressure in the auxiliary reservoir is automatically varied to correspond with the variations of the load upon the car-trucks, substantially as described.

2. In an air-brake mechanism, the combination, with the train-pipe, auxiliary reservoir, brake-cylinder, and triple-valve-operating piston, of a valve mechanism connected with said piston, whereby the pressure in the auxiliary reservoir is automatically maintained at the proper degree to insure that the pressure on the brake-shoes shall always bear the proper relation to the weight of the car whether it be light or loaded to any degree, substantially as described.

3. In an air-brake mechanism, the combination, with the train-pipe, auxiliary reservoir, brake-cylinder, and triple-valve-operating piston, of valve mechanism connected with said piston for changing the relative pressures in the train-pipe and auxiliary reservoir, and means whereby said changes are automatically effected to conform to the load by the variation in the space between the body of the car and the stationary part of its truck due to the compression of the springs under variations of load upon the car, substantially as described.

4. The combination, with an air-brake mechanism, of a piston actuated by direct pressure from the train-pipe governing the admission of air through a port leading to the auxiliary reservoir, another piston beyond said port actuated by the air that has passed through the port, and a lever connecting the back of the first with the front of the second piston, whereby the direct action of the second piston is transmitted against the back of the first piston, substantially as and for the purposes described.

5. The combination, with an air-brake mechanism, of a direct-pressure piston governing the air-port to the auxiliary reservoir, a piston beyond said port actuated by air that has passed through the port, a connecting-lever, and an adjustable fulcrum, with means adapted to shift said fulcrum along the connecting-lever, whereby the second piston is caused to exert a greater or less pressure against the first piston, substantially as and for the purposes described.

6. The combination, with an air-brake mechanism, of a piston governing the port to the auxiliary reservoir, a piston beyond said port, and a connecting-lever with an adjustable fulcrum, of a lever fulcrumed on the car with one of its arms engaged with the truck, said lever connected with the said movable fulcrum, whereby the relative depression of the car on its springs due to variations in the load operates through said intermediate connections to automatically shift the said fulcrum in a corresponding degree, substantially as described.

7. The combination, with the two pistons,

connecting-lever, adjustable fulcrum, and the lever engaging the car and its truck with intermediate connections, of the slot e^2 and link, whereby the throw of said last-named lever may be adjusted to shift the adjustable fulcrum through the proper range corresponding with no load and a maximum load on the car, substantially as described.

8. The combination, with the two pistons, their connecting-lever, and air-port f to the auxiliary reservoir, of a valve governing the ports f' and f^4 to the brake-cylinder, said valve having play, substantially as described, with respect to the piston F, whereby the piston may be moved to close the passages from the auxiliary reservoir to the brake-cylinder and to open the port f without opening the brake-cylinder to the exhaust, thereby permitting the engineer to recharge the auxiliary reservoir while the brakes are set, substantially as described.

9. The combination, with the two pistons, their connecting-lever, the adjustable fulcrum, and its automatical shifting mechanism, of a yielding resistance and a spring in the connections between the car and the said fulcrum, whereby vibrations of the car-springs, due to the usual roughness of the railway-track, is compensated without shifting said fulcrum, substantially as described.

10. The combination, with an air-brake mechanism, of a valve governing the port from the train-pipe to the auxiliary reservoir and adapted, also, to actuate the valve mechanism governing the port or ports through which the air is admitted from the auxiliary reservoir to the brake-cylinder in the manner described, and in connection with said first valve a yielding resistance, as G G′, whereby, when it has been advanced to set the brakes, it is caused to return slowly, thereby shifting said second valve mechanism to close its admission-port without driving it far enough to open the exhaust and at the same time opening the port from the train-pipe to the auxiliary reservoir, whereby the latter may be recharged while the brakes are yet set, substantially as described.

11. The combination, with an air-brake mechanism, of a valve governing the port to the auxiliary reservoir, a brake-cylinder valve associated with and operated by the first-named valve in the manner described, and yielding resistance, as G G′, for retarding the return motion of the first valve after the brakes are set, as explained, the same consisting of a dash-pot and valve, whereby it is free in its initial movement and restricted in its return movement, substantially as and for the purposes set forth.

12. The combination, with an air-brake mechanism, of means for providing a local escape from the train-pipe in an emergency stop, the same consisting of the dash-pot valve and springs J′ J^3, said plunger adapted to be actuated by a moving part when making an emergency stop to open the valve, after which the valve is closed by one of the springs and subsequently aided by the other spring to hold it closed, substantially as and for the purposes described.

In testimony whereof I signed this specification in the presence of two witnesses.

HENRY S. HOPPER.

Witnesses:
F. CLOUGH,
W. W. LEGGETT.